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RICHMOND, VIRGINIA

To: R. Cox and J. Whidby
From: D. C. Watson and J. Crump
Subject: Comparative Moisture Levels ~~Marlboro versus Winston~~

Date: July 24, 1986

Marlboro and Winston cigarettes from C.I. pickups were received for analyses to define what, if any, differences might exist in the 'Oven Volatiles'. The samples and their dates and locations of manufacture are listed in the appendix.

The analyses performed included:

Standard Oven Volatiles
GC Water
Humectant levels both pre- and post-OV
Collection of volatiles during modified OV
Equilibrium moisture at various RH levels

SUMMARY:

The direct comparison of the Marlboro and Winston cigarettes showed:

- The two brands left the factories at essentially the same OV levels.
- Winston from C.I. pick-ups had a higher moisture level than did the Marlboro cigarettes from the same pick-up regions.
- The two brands responded along essentially the same isotherm for OV as a function of RH at equilibrium conditions.
- Marlboro was made with significantly greater levels of PG than Winston.
- PG contributed significantly to the OV values.
- Winston OV values were higher than Marlboro values even after correcting them for loss of PG during OV.
- Water extractable by methanol (GC Water) was higher in Winston than in Marlboro.
- The H₂O losses observed during shipping and storage of products cannot be attributed to the OV vs RH isotherm of the tobacco.
- Comparisons of 'Fresh' versus C.I. pick-ups for Marlboro may be in error due to significant changes in the humectants.
- Volatiles collected during OV determinations contain significant quantities of non-water components.

CONCLUSION:

These tests indicated that even though the equilibrium moistures do not differ, there is a difference in the water levels of Marlboro versus Winston both 'fresh' and after storage and distribution. Additional work is planned concentrating on fresh samples to determine the source of the observed differences.

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EXPERIMENTAL:

One point of potential confusion in comparing data is found in the differing levels of humectants. A summary of the as-received Oven Volatiles and the humectant effects on the observed weight loss is shown in Table 1 below.

TABLE 1

(location)	MARLBORO BOX		MARLBORO SOFT PACK			WINSTON SOFT PACK		
	1	2	1	2	3	1	2	3
OV (as received)	11.8	11.9	11.2	11.7	12.6	12.5	12.4	12.7
PG (pre-OV)	1.16	1.18	1.15	1.31	1.70	0.78	0.77	0.86
PG (post-OV) *	0.68	0.72	0.69	0.78	1.03	0.53	0.53	0.54
GLYC (pre-OV)	1.82	1.94	1.86	1.95	2.24	2.63	2.43	2.77
GLYC (post-OV) *	1.81	1.84	1.78	1.88	2.07	2.48	2.47	2.58
TEG (pre-OV)	0.80	0.71	0.82	0.57	ND	ND	ND	ND
TEG (post-OV) *	0.78	0.67	0.77	0.52	ND	ND	ND	ND
Corrected OV**	11.3	11.3	10.6	11.1	11.8	12.1	12.2	12.2
GC Water	10.4	10.4	9.7	10.0	10.4	11.7	10.9	11.1

(location) 1 - combined from CI pickups from Phoenix and Sacramento

2 - combined from CI pickups from Atlanta and Miami

3 - 'fresh' Marlboro from M/G QA link and Winston from purchase in Virginia

* Based on 'Pre-OV' (as-received) weights

** OV corrected for loss of humectants

These data emphasize the need to consider the loss of 'non-water volatiles' during Oven Volatiles determinations. Specifically, the apparent agreement in OV data between Fresh Marlboro and Fresh Winston (12.6% vs. 12.7%) is found to be due, in part, to a loss of about 0.5 % PG from the Marlboro. Comparisons of Fresh versus CI pick-up Marlboros can be misleading for the same reason.

Although the data for the GC Water is based on only single analyses, Winston data are higher than Marlboro in all cases. GC water is lower than the corrected OV by about 1% absolute.

Capillary chromatographic profiles of the volatiles that were collected during a modified Oven Volatiles procedure were compared for the Fresh samples of Marlboro and Winston (Table 2). They confirmed the approximately 40% (relative) loss of PG during these determinations. Nicotine was determined in the collected volatiles in the amount of about 0.04 %. Other than the PG levels and the presence of known aftercut components in Marlboro there were no qualitative differences and no significant quantitative differences between Marlboro and Winston volatiles.

To determine if the OV or moisture differences were due to differences in filler equilibrium levels, isotherms were generated for each sample by

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equilibrating approximately 20 grams of each at three RH levels. Because of the limited amount of material available, this was accomplished as follows:

1. The approximate 20 grams was split into two nearly equal samples and placed into tared 3.5 inch diameter aluminum OV cans.
2. Initial sample weights corresponding to the as received material were recorded.
3. The samples were then equilibrated in an environmental chamber at 75 deg. F and RH levels of 81%, 61% and 43% (sequentially). Sample weights were recorded at each equilibrated condition.
4. After the final equilibration at 43% RH, one can of each sample was analyzed for humectant levels. OV measurements were made on the remaining samples which were then analyzed for post-OV humectant levels.
5. Using the dry weight basis for each sample (determined from the OV measurements), OV's were calculated for the samples on both an as-received and on an as-equilibrated basis.

The results are tabulated in Table 3 and are shown plotted in Figures 1-3. The Marlboro samples always yielded higher equilibrated OV's than the Winston samples. However, most if not all of the difference can be accounted for by differences in the levels of non-water volatiles in the samples. The most significant of these is PG of which considerable percentages were lost during equilibration and during OV testing. Unfortunately, there is no way of determining from the limited data at what rate the PG was lost during the three stages of equilibration.

These equilibrations were performed in an environmental chamber with an air exchange of 500 CFM over a period of six days. It is worthy of note that more PG was lost during this period than was lost during the OV measurements. Corrections have been made for the PG loss which occurred during the OV measurement made on the samples equilibrated at 75 deg. F / 43 % RH and these corrected values are given in Table 3. Within the confidence limits of the measurements (\pm 0.4% for a single OV test at 95% confidence), all of the samples equilibrated at this RH to essentially the same level. Corrections have also been made for as-received OV's to account for PG lost during storage and during the OV test.

Based on these results it is unlikely that differences in OV's found for packs of Marlboro and Winston picked up from various locations can be attributed to differences in their equilibrium moisture levels. The data suggests that the most likely explanation would be differences in the moisture levels at which the cigarettes are packed and/or differences in seal efficiency.

The as-received OV's for the fresh Winstons were generally higher than those for the fresh Marlboro. Assuming that they represent or are close to the pack-out moistures, one might conclude that Winston is packed-out at a slightly higher moisture level than Marlboro (see Table 4). Additional samples of 'Fresh' Winston and Marlboro have been requested and will be submitted for definitive analyses relative to the amount and source of any 'moisture' differences.

Attachments

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